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Synchronizing Fire Support for Heavy/Light Operations: -- A Command and Control Challenge for the Heavy Division

A Monograph
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A COMMAND AND CONTROL CHALLENGE FOR THE HEAVY DIVISION
by MAJ David S. Powell, USA, 65 pages.

This monograph examines the fire support command and control problems that confront a heavy division during synchronization of heavy / light operations. The destructive force of massed fire support is a critical component of heavy / light combat power. Command and control optimizes that combat power by effectively synchronizing fire support.

Communications and procedures are two key elements of fire support command and control. This monograph examines these two elements from a historical, contemporary and theoretical perspective. It examines communications in terms of equipment and net structure, and examines procedures in terms of the timeliness of planning, coordination and execution.

The monograph first evaluates VII Corps operations on the Cotentin Peninsula, in June 1944, as a historical example. Insights into this operation show some of the difficult command and control challenges that units faced in synchronizing fire support for heavy / light forces. Communications and procedural deficiencies caused these problems.

Next, the monograph focuses on contemporary heavy / light experience at the heavy brigade level. Two National Training Center rotations and REFORGER 88 provide key lessons learned. Fire support synchronization problems were a recurring problem in all three cases due to communications inadequacies and procedural differences. These problems demonstrate that unresolved command and control problems can easily jeopardize the potential combat power of the heavy / light force.

Finally, an analysis of current heavy division capabilities points out key fire support command and control problems similar to those found in the previous cases. These problems included communications incompatibility plus procedural delays which could easily undermine the powerful synergism of heavy / light operations if not resolved.

Based on historical insights, contemporary lessons learned and analysis of current capabilities, the study concludes that serious command and control problems exist in the areas of fire support communications and procedures. If not resolved, these deficiencies could significantly degrade the overall capabilities of the heavy / light force. Possible solutions are addressed in terms of doctrine, equipment, force structure and training. Solving these problems will help to ensure that the potential combat power of the heavy / light force is optimized for the European battlefield.

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I - INTRODUCTION

Background and Significance

The purpose of this paper is to identify and examine key command and control (C^2) problems that the U.S. Army AOE Heavy Division must overcome in order to effectively synchronize fire support for heavy/light operations. Previously, there was a tendency to organize doctrine by echelon and type of organization, as either heavy or light.[1] Today there is a critical need to go beyond this either-or focus.

Recently, the concept of heavy / light operations has generated great interest and debate. The early deployment of light forces to reinforce NATO has strategic, operational and tactical appeal. From a strategic perspective, strong arguments conclude that rapid deployment of light forces to Europe during conditions of increased military vigilance would have a strong and positive effect on deterrence. From an operational and tactical standpoint, light forces complement heavy forces by allowing the mixed force commander to optimize his combat power.[2]

The heavy / light concept has many strong points and many believe that future tactical battles in Europe will be fought by such a mix of forces.[3] Therefore, it is imperative that tactical level organizations continue to analyze the many difficult challenges involved in planning and executing heavy/light operations.

Synchronization is one of the greatest of these challenges. The goal of synchronization in heavy/light operations is to maximize the strengths of each force by achieving functional compatibility within a common tactical setting.[4] Heavy and light forces are complementary, but not interchangeable. The commander achieves functional compatibility by offsetting the weaknesses of one force with the strengths of the other. In this sense, heavy/light operations are an extension of the combined arms concept.[5]

A key task of C^2 in heavy / light, combined arms operations is to integrate both the organization and employment of forces. C^2 achieves integration through the synchronization process. This process produces maximum potential combat power and then translates it into destructive force that is focused and applied at the decisive point.

A critical condition for maximizing heavy / light combat power is the effective integration of fire support. This is especially important because of the austere combat support that is organic to light forces.

Fire support is a critical battlefield operating system for the heavy / light force. It both provides and integrates destructive force. Failure to synchronize results in a piecemeal distribution of fires instead of the concentrated destructive force of massed fires that is so important for optimizing the heavy / light mix.

Methodology

The scope of this paper is confined to examining fire support C^2 for heavy /light, defensive operations at division level and below. The tactical setting is a high intensity conflict in NATO, against Soviet / Warsaw Pact forces. Employment considerations are consistent with current doctrine and mission capabilities.

Integration of fire support into heavy / light operations presents a wide range of key issues for analysis.[6] This study specifically analyzes the fire support C^2 in terms of communications and procedures. It does this from a historical, contemporary and theoretical perspective.

The study first examines fire support communications using these criteria:

- equipment operating range
- equipment availability
- equipment compatibility
- equipment security
- communications net design/structure

Next, the study examines fire support procedures using the following criteria:

- planning times
- coordination times
- execution times

The heavy division time standards from the field artillery battalion ARTEP Mission Training Plan serve as a base line for the analysis.[7] The rationale is that heavy force systems used to plan, coordinate and execute fire support tasks will drive the pace and tempo of fire support operations in a European setting.

Historical insights, contemporary lessons learned, and observations from the analysis of current capabilities serve as evidence. Sources include unit after action reports, historical observations / lessons learned, observations and lessons learned from the National Training Center (NTC) and REFORGER, doctrinal and technical publications, force structure documents, current articles and related studies.

II - HISTORICAL INSIGHTS

Background

Operations on the Cotentin Peninsula in Normandy during the period of 6 June to 17 June 1944, provide several excellent examples of heavy/light operations involving units from the VII (U.S.) Corps and two U.S. airborne divisions. VII Corps operations on the east side of the peninsula constituted the right flank of the allied invasion known as Operation Neptune. The VII Corps mission was to assault Utah Beach and to secure a beachhead in order to facilitate an early attack north

to seize critical port facilities at Cherbourg.[1]

Some of the hardest fighting during the early days of the Normandy invasion took place on the Cotentin Peninsula.[2] Early operations by the 82nd and 101st Airborne Divisions preceded the invasion in order to secure key road networks and to establish a defensive arc along the edges of the invasion area. The 4th, 90th and 9th Infantry Divisions of VII Corps conducted landing operations in sequence during the first five days of the invasion.

After the landing at Utah Beach, there were several major operations involving both heavy and light units. The 4th Infantry Division (4ID) conducted early heavy / light operations in order to seal the northern flank of the invasion area. The forces working with the 4ID included the 505 Parachute Regiment of the 82nd ABN, plus supporting tank units and reinforcing armored artillery. The 90th Division attacked west through the remainder of the 82nd ABN Division in order to seal off the southern portion of the peninsula. Finally, the 9th Division and the 82nd ABN Division spearheaded a combined attack through the stalled 90th Division to finish sealing off the Cotentin.[3]

All of these heavy / light operations took place in the restrictive terrain of the Cotentin Peninsula. This hedgerow terrain, known as the Bocage, gave VII Corps a good opportunity to experiment with different combined

arms mixes, which included airborne infantry, regular infantry, armored forces, towed artillery and armored, self-propelled artillery. This mixing of heavy and light forces from different organizations caused many command and control complications and thus provides a useful example for analysis.

Fire Support Communications - Analysis and Findings

Analysis overview. Fire support organizations used a variety of radio and telephone systems to synchronize fires in this operation. The type and capabilities of the equipment were diverse.[4] Analysis of World War II doctrine, force structure, unit histories, after action reports and lessons learned, reveals that there were fire support communications problems in the heavy/light operations. These problems caused some C^2 problems that adversely impacted on synchronizing fire support.

Findings. The findings are according to the specific criteria used in the analysis.

- Equipment Operating Range. Radio communications were the primary means used during the Cotentin operations.[5] Within the 4ID heavy / light mix there were four different types of radios in the heavy / light fire support system. The operating ranges varied from 5 to 15 miles.

The primary radio was the SCR 619 which had a five mile range limit. The other radios were the SCR 508,

SCR 510 and VRC 9, all of which had a 10-15 mile range. Tank and armored artillery units used the SCR 508 and SCR 510 radios which which gave them three times the range of the SCR 619 radios used by the light infantry, regular infantry, and the divisional artillery units.[6]

A forward observer from a division artillery unit used an SCR 619 radio with its five mile range to support tank forces using radios with a 10-15 mile range. These mixed operating ranges, combined with the rugged hedgerow terrain, forced forward observers to employ radio relays between themselves and supporting artillery battalions.[7]

- Equipment Availability. Shortages in communications equipment existed in many fire support organizations. This created a significant C^2 problem because not all liaison officers and forward observers could be properly equipped or employed.[8] Radio shortages also severely hampered radio relay operations.

- Equipment Compatibility. Compatibility problems occurred because of differences in frequency coverage. The SCR 500 series radio used by tank and armored artillery units operated in a frequency range of 27-36.9 megacycles. The SCR 600 series radio in airborne units, regular infantry units and infantry division artillery units operated in a frequency range of 20-27.9 megacycles.[9] In some cases, certain radios in the 500 series had no overlap with the 600 series.

This lack of adequate frequency coverage caused a compatibility problem that affected fire support in heavy/light operations. Forward observers in tank units had difficulty communicating with supporting light or medium artillery as well as monitoring the tank unit command net. Also, reinforcing armored artillery could not easily communicate with direct support light or medium artillery, unless liaison officers with radios were exchanged.[10]

- Equipment Security. None of the equipment had a secure capability. Designated codes and call signs provided limited communications security. The frequent mixing of units jeopardized even this limited capability because it was difficult for parent units to keep track of and disseminate codes and call signs in an ever changing task organization.[11]

- Net Structure. Solutions to the compatibility problem involved improvising and modifying fire support communications net structures. One solution was to designate artillery fire nets within the very narrow overlap of frequencies. This caused conflict and doubling up of fire nets.[12]

Fire Support Procedures - Analysis and Findings.

Analysis Overview. Fire support organizations used well-defined procedures for planning, coordination and execution of support. In many ways these procedures

parallel contemporary doctrine. Units achieved effective fire support during operations on the Cotentin using these procedures.[13] However, there were some procedural problems that affected fire support C^2.

Findings. The findings are according to the specific criteria used in the analysis.

- Planning Times. There was not any evidence to indicate the C^2 problems affected fire support planning. However, it is reasonable to conclude that communications operating range limitations and compatibility problems would have made heavy/light fire support planning more difficult.

- Coordination Times. Communications compatibility and range problems slowed fire support coordination. The direct support artillery in the 4ID heavy/light operation was the focal point of fire support coordination. In order to coordinate with the 505 Parachute Regiment, with supporting tank units, and with reinforcing artillery units, the 4ID direct support artillery had to overcome both range and compatibility problems.

- Execution Times. Forward observers routed fire mission requests through radio relays and liaison officers to overcome range and compatibility problems. This routing caused delays in fire support execution times for the heavy/light forces. Also, heavy artillery required separate firing data for each howitzer. This

meant additional gunnery calculations, which delayed execution of any massed fires involving reinforcing heavy artillery units.[15]

Solutions and Insights

Overview. The fire support community worked hard to resolve the various communications and procedural problems. Approaches included both short term ad-hoc fixes and also recommendations for long term solutions. It is useful to highlight some of these solutions.

- Doctrine: Separate sections in existing fire support doctrine outlined detailed options available to minimize the impact of range and compatibility problems. These options included adjusted radio net structure, radio relays, aerial observers and multiple liaison officers.[16] The First Army Artillery Information Service provided a quick way to supplement existing doctrine by distributing fire support lessons learned.[17] Also, the development of graphical firing tables helped to reduce the computation times for massing heavy artillery.[18]

- Equipment: Due to a need for more radios, VII Corps received excess radios from First Army stocks. These helped to resolve equipment range, availability and compatibility problems for the near term.[19] Excess SCR 500 series radios went to field artillery units in infantry and airborne divisions to help resolve

compatibility problems with armor units. Relay sites used excess radios to resolve range problems. Requests for long term adjustments to tables of organization and equipment documented the equipment deficiencies and helped to insure permanent solutions in the future.[20]

- Force Structure: Aggressive use of liaison officers helped to minimize the impact of compatibility problems. The use of organic aerial liaison aircraft helped resolve some communications range problems. Recommended changes to the tables of organization and equipment documented liaison section shortfalls.[21]

- Training. Army combat evaluation teams were present during the operations on the Cotentin. They developed numerous battlefield lessons learned which provided valuable material that was immediately available for training during lulls in the fighting. This training helped units overcome and adjust to unique problems identified during combat operations in the hedgerow operations on the Cotentin.[22] One of these lessons was the value of aerial liaison aircraft for coordinating fires in heavy / light operations.

Insights. Units conducting heavy/light operations on the Cotentin Peninsula faced significant C^2 problems in fire support communications and procedures. Figure 2-1 summarizes these problem areas in terms of category, criteria and operational impact.

Figure 2-1

Fire Support Command and Control Problem Areas

CATEGORY/ CRITERIA	IMPACT *NEGLIGIBLE	**SIGNIFICANT
COMMUNICATIONS		
RANGE		X
AVAILABILITY		X
COMPATIBILITY		X
SECURITY	X	
NET STRUCTURE	X	
PROCEDURES		
PLANNING TIMES	X	
COORDINATION TIMES		X
EXECUTION TIMES		X

* Negligible Impact - There was no impact or the heavy / light forces overcame the problem using internal resources and minor procedural adjustments.

** Significant Impact - The heavy / light forces reduced the impact of problems but could not totally resolve the problem without augmentation or significant restructuring of operational procedures.

Units minimized the impact of these problems through an aggressive and at times ad hoc approach that worked. Their relative success in integrating fire support, in spite of C^2 problems, points to the value of: detailed doctrinal procedures for working around the problems; sufficient numbers and types of radios; multiple and experienced liaison officers; and valuable battlefield lessons learned that received wide and timely distribution to users.

III - CONTEMPORARY LESSONS LEARNED

Background

Analysis of three contemporary cases of heavy / light operations produces specific lessons learned concerning fire support synchronization. Using the criteria established in chapter one, the analysis focuses specifically on fire support C^2 in terms of communications and procedures.

Overall, these three cases are very much in line with the focus of current heavy / light operational concepts. The cases are also similar in many respects to the historical example in chapter two. However, there are important differences in terms of tempo, threat, scale and training simulations. The tempo was that of a modern, European, high-intensity battlefield. The threat forces simulated Soviet operations in two of the cases. The scale of operations in each case was reduced in comparison to operations on the Cotentin Peninsula. Each case also included training simulations plus observers for evaluation and data collection.

Two of the cases are 1988 rotations at the National Training Center which evaluated operations involving a heavy brigade with a light infantry battalion, plus appropriate combat support and combat service support assets. In these cases, the heavy/light forces conducted defensive operations in a high intensity, European scenario against a Soviet type threat.[1]

The third case occurred during REFORGER 1988 and involved a light infantry battalion operating with an armored cavalry regiment as part of a corps defense.[2] The light battalion deployed from CONUS and participated in heavy/light defensive operations conducted on the European, high-intensity battlefield. An armored cavalry regiment plus two armored divisions made up the opposing force.

Fire support in each case included light infantry fire support elements (FSEs) and fire support teams (FISTs) for the light battalions. Other fire support assets involved were organic to the heavy forces.

Fire Support Communications Analysis and Findings

Analysis Overview. Fire support organizations in all three cases used a variety of radio and wire systems to synchronize fire support. Analysis of after action reports, observer/controller findings, and unit take home training packages reveals key communications problems in these heavy/light operations. These problems degraded fire support synchronization.

Findings. Findings are listed according to the criteria used in the analysis.

- Equipment Operating Range. The limited FM operating range of the light force PRC 77 and GRC 160 radios caused persistent communications disconnects between key fire support agencies. The following matrix

highlights fire support radio systems by user, type and operating ranges.

HEAVY BDE FSE	DS/REINF FA BN	LT BN FSE	LT BN FISTS/FO	RADIO	RANGE KM
			X	PRC 77	
				w/ whip	8
				w/ long wire	28
		X		GRC 160	
				w/ whip	8
				w/ OE 254	19
				w/ long wire	28
X	X	X		VRC 46	
				w/ whip	40
				w/ OE 254	58

Light FISTS experienced communications problems during fire mission processing due to range limitations. During a stay *behind mission* one light battalion FSE also experienced range problems which affected fire support planning and coordination actions with the heavy brigade FSE.[3] The diagram in Appendix C portrays these range problems.

- Equipment Availability. There were insufficient numbers of radios to meet all the fire support requirements. Both heavy and light fire support agencies needed extra radios for the liaison teams exchanged between the light battalion FSE and the heavy DS artillery battalion. Also, there was limited redundancy in the light fire support system to provide backup in case of equipment failure. The light battalion FSE had the only light force VRC 46 and VRC 49

(FM RETRANS) capability. The light FISTs had only two PRC 77's while light FO's had only one PRC 77.[4] Heavy units needed more radios to operate the extra voice nets required due to TACFIRE compatibility problems.

- Equipment Compatibility. TACFIRE is an automated fire control system that uses digital communications nets. Voice traffic on digital nets disrupts digital traffic. In these cases the light FSE, FISTs and FOs used voice systems to communicate with the TACFIRE equipped brigade FSE and direct support (DS) / reinforcing artillery battalions. Appendix C highlights linkages affected by these compatibility problems.

- Equipment security. FM secure radio was a primary link between heavy and light forces.[5] Both the heavy and light forces had the capability to conduct secure communications on all fire support nets.

- Net Structure. Communications compatibility problems caused increased voice traffic requirements. The brigade FSE and direct support/reinforcing FA battalions had to modify the heavy fire support net structure by adding additional nets to accommodate the light force voice nets.[6]

The light battalion FSE working with a heavy brigade creates a net structure problem. The light battalion FSE must operate on six different nets. Two of these are especially critical for fire support operations. The DS battalion fire net is the primary net for processing fire missions. The DS battalion

operations/fire net is used for fire support planning and coordination. Both of these heavy DS artillery nets are digital.

Because the light battalion FSE does not have a digital capability, the DS battalion must create two additional voice nets to compensate. The brigade FSE and reinforcing artillery must also monitor these two additional voice nets. [7]

Fire Support Procedures Analysis and Findings

Analysis Overview. In all three cases, fire support agencies used doctrinal procedures for planning, coordination and execution of fire support.

Findings. The findings are listed according to the criteria used in the analysis.

- Planning Times. Communications problems caused excessive planning times and impacted adversely on fire support synchronization. Range limitations and light force incompatibility with TACFIRE caused disruptions that delayed the planning process.

Another factor was the heavy force's lack of understanding of light force planning time requirements. Light units faced compressed planning times because many operations required them to begin movement much earlier than heavy forces. The heavy brigade level staff often violated light force planning time constraints. Thus, the heavy brigade fire support officer did not finish

the planning process in time to transmit it to the light battalion for review, calculations and rehearsal.[8]

A final procedural problem arose from the TACFIRE compatibility difficulty. Heavy force standard operating procedures were designed for automated planning techniques using digital communications. The operators lacked the proficiency to adequately integrate manual procedures with automated procedures. This caused additional delays in planning times.[9]

Several examples demonstrate that the cumulative impact of these planning time delays was significant. The impact was especially critical at the task force level. On several occasions planning time overruns at brigade prevented task force FSEs from refining, disseminating and rehearsing fire plans. Because planning was deficient, fire plan execution was flawed.

During one operation the light task force initiated movement before the light FSE could resolve major fire plan problems with the heavy brigade FSE. During another operation, the light FSE was unable to plan fires to support a light force contingency plan for an air insertion. During several operations, light task force FSEs were not able to integrate all the targets selected by the brigade FSE. These examples highlight the adverse impact of delays in planning times.[10]

- Coordination Times. Excessive planning times resulted in incomplete and unrehearsed fire support

plans. This generated additional coordination requirements for FISTs and FSOs to resolve by radio. The previously discussed communications range and compatibility problems adversely affected the critical fire support coordination linkages between light forces and the heavy brigade FSO and also the DS and reinforcing artillery battalions. These conditions had a collective impact that caused excessive coordination times to clear and mass fires.[11]

Two examples demonstrate the collective effect of the excessive coordination times. During one airmobile operation excessive coordination time caused a ten minute delay in scheduled fires for an airmobile operation and forced inbound aircraft to land while the fire support system resolved the problem and executed the fire plan. During another operation, when friendly forces moved too close to a planned target, coordination delays prevented cancellation of the scheduled fires and resulted in fratricide.[12]

- Execution times. Communications operating range limitations and compatibility problems caused a number of unacceptable delays in requests for fire support and in fire support execution. In several cases, delays in fire mission execution resulted in fratricide. These deadly delays stemmed from excessive communications relay times for FIST fire mission requests during friendly forces movement. Thus, accurate, but late fires hit friendly forces which had

moved in the vicinity of the target during fire mission execution.[13]

Because of compatibility problems, TACFIRE equipped direct support and reinforcing artillery battalions were not always responsive to voice calls-for-fire from the light forces. Voice calls-for-fire are the exception rather than the rule in the TACFIRE digital system. Thus, the supporting TACFIRE artillery battalions were not accustomed to operating with voice nets.[14]

Solutions and Lessons Learned

Solutions. In each of the contemporary cases examined, the units devised various solutions to resolve some of these fire support C^2 problems. Approaches included "quick fixes," as well as recommendations for future, longer term solutions. The units achieved varying degrees of success in terms of doctrine, equipment, force structure and training. The four categories below highlight various solutions.

- Doctrine. Several adjustments reduced the impact of communications and procedural problems. Changes in the DS artillery battalion communication nets helped to accommodate extra light force voice net requirements. Top-down planning, directed and controlled by the brigade FSE, helped heavy force planners at the brigade and supporting artillery battalions meet the compressed planning time

requirements of light forces. On one occasion, a voice quick fire channel plus priority of fires produced increased responsiveness to the light task force.[15]

- Equipment. Solutions included radio redistribution and external augmentation. This increased light fire support communications redundancy and provided supporting TACFIRE artillery battalions the radios for extra voice nets. Centralized control of FM retransmission systems helped to minimize range problems between light FISTs and supporting artillery battalions. One unit achieved a short term fix to communications range problems by utilizing an aerial C^2 platform.[16]

- Force structure. Fixes included using several variations of out-of-hide liaison officers with communications and transportation capability. In one case, a light task force LNO at the heavy brigade continually provided valuable information for the FSE.[17]

- Training. As each case progressed, the ongoing training made important contributions to overcoming fire support C^2 problems. Specific examples of training related improvements included: increased proficiency in compressed planning procedures; smoother communications using a mix of voice and digital nets; and better integration of light force manual procedures with automated TACFIRE procedures.[18]

- Lessons Learned. Many so-called lessons learned are not in fact new lessons. Instead, they are

often just a validation of basic doctrinal issues. In the three cases examined, there were several such lessons learned that were especially important in the heavy / light context.

First, a good mutual understanding of respective capabilities and limitations sets the stage for effective fire support synchronization. Next, demanding training will help to minimize many of the C^2 problems inherent in heavy/light operations. Lastly, expanded unit operating procedures incorporate standardized techniques for reducing the impact of compatibility problems and compressed planning time requirements.[19]

Figure 3-2 summarizes the command and control problem areas of the three cases in terms of category, criteria and operational impact.

Figure 3-2
Fire Support Command and Control Problem Areas

CATEGORY/ CRITERIA	IMPACT NEGLIGIBLE	SIGNIFICANT
COMMUNICATIONS		
RANGE		X
AVAILABILITY		X
COMPATIBILITY		X
SECURITY	X	
NET STRUCTURE	X	
PROCEDURES		
PLANNING TIMES		X
COORDINATION TIMES		X
EXECUTION TIMES		X

IV - ANALYSIS OF CURRENT CAPABILITIES

Background

The division level, tactical operations exercise from the School of Advanced Military Studies provides the tactical setting for this analysis of current capabilities. The exercise focused on planning and execution of defensive and offensive operations, conducted by U.S. Army heavy and light forces as part of a U.S. Army corps, in a central European setting. It is well suited for this heavy/light analysis.

This analysis focuses on the U.S. 52nd Mechanized Division during the defensive phase of the exercise. The 52nd Mechanized conducted defensive operations in sector and was to be prepared to conduct a counterattack during phase III. The 1st Bde/21st LID, plus its direct support artillery battalion were attached to the 52nd. Additionally, the 66th FA Bde provided general support/reinforcing fires to the 52nd DIVARTY. (See task organization highlights at Appendix D).

The Soviet 28 Combined Arms Army (CAA) was conducting offensive operations against the 52nd Mech division. It consisted of three motorized rifle divisions and one tank division. The 28 CAA deployed with three motorized rifle divisions in its first echelon, along with an independent tank regiment as a forward detachment, and its tank division organized as an operational maneuver group.

The 52nd Mech Division concept was to defend with two heavy brigades and one light brigade on line. The additional heavy brigade was in reserve. The 1st Bde/21st LID was forward and defended on the west flank of division sector. It defended in rugged terrain well suited for light force operations.

The 2-45FA (105mm Towed) provided direct support for the light brigade. The 2-641FA (155mm Self Propelled) from the 56th BDE provided reinforcing fires. The 2-45FA is a light divisional, non-TACFIRE battalion. It provides fire support teams (FISTS) and fire support elements to the light brigade. The 2-641FA is a non-divisional, TACFIRE equipped battalion. It does not have organic FSEs or FISTs. It does have a limited, non-TACFIRE liaison capability.

Fire Support Communications Analysis and Findings.

Analysis overview. The fire support communications capabilities in this analysis are different from those described in the cases in chapter three. The differences are in terms of the scope of the operation and the size of units involved. Chapter three focused on light battalions operating in support of heavy brigade defensive operations. This chapter focuses on a reinforced light brigade supporting a heavy division. The communications capabilities used in this operation include a mix of radio and wire systems. FM radios are

the primary means used to conduct fire support operations in this scenario.

Findings. Findings are listed below according to the specific criteria used in the analysis. Appendix E is a portrayal of the communications problem areas and supplements the following discussion.

- Equipment Operating Range. There is a significant difference in operating range limits for radios used by key elements in this heavy/light fire support system. The following matrix highlights radio systems by user, type and operating ranges.

S2d DIVARTY	DS BN	REINF LT BDE BN	FSO	LT BN FSO	Radio	Range
				X	AN/PRC-77	
					with whip	8
					with long wire	28
			X	X	AN/GRC-160	
					with whip	8
					with OE 254	19
					with long wire	28
X	X	X	X		AN/VRC-46	
					with whip	40
					with OE 254	58

Several conditions could cause fire support communications range problems. A light brigade frontage in excess of 8-10 KM would cause potential problems in the link between a FIST on the brigade flank and the supporting artillery battalions. FISTs in light forces with a stay behind mission or a covering force mission would be quickly out of range (whip antenna) of

supporting artillery battalions in the main battle area. Appendix E portrays these potential problems.

Equipment Availability. The AN/PRC-77, the AN/GRC-160, and the AN/VRC-46 are used in the light brigade fire support structure. However, there is little or no redundancy of systems. The light FSEs must operate on at least five nets at various times. Each FSE has two radios plus a retransmission capability.

One recommendation is that heavy forces augment the light forces with complete sets of TACFIRE equipment.[1] This equipment does not exist for either pre-positioning or augmentation.[2]

Equipment Compatibility. Some of the systems used by the heavy forces are not compatible with those of the light forces. In this scenario the DIVARTY, the Division FSE and the reinforcing battalion are TACFIRE equipped and operate on a mix of voice and digital communications nets. The light fire support elements operate on voice nets only. Voice communications on a digital net disrupt digital communications. This incompatibility problem directly affects three key links in this setting. Appendix E highlights the linkages affected by compatibility problems.

Equipment Security. All of the communications systems meet minimum requirements. Light and heavy forces have a secure capability for all nets.

Net Structure. Because of the mix in digital

and voice systems, the standard fire support net structure in a heavy division would require some modification to accommodate heavy/light fire support operations. Specifically, the division FSE, the DIVARTY and the reinforcing battalion must alter net structures by adding a voice net as an alternative to the digital DIVARTY fire/operations net. This would accommodate the light brigade FSE and DS battalion voice nets.

Fire Support C^2 Procedures Analysis and Findings.

Analysis Overview. In this setting, the doctrinal procedures for fire support planning, coordination, and execution produce mixed results.

Findings. The findings below are listed by the criteria used in the analysis.

Planning Times. Fire support planning is an ongoing process that involves acquiring and analyzing targets, plus allocating, scheduling and integrating fire support assets to attack the targets.[3] The lack of digital communications compatibility has a direct effect on all of these actions.

The light brigade FSO is the master planner for fire support in his sector. However, he faces a significant problem. He has no access to the TACFIRE system which is both the hub of communications and the tactical information database for the heavy division fire support system. This situation forces a mixing of both automated and manual planning procedures. The planning

process slows down at the nodes where automated and manual procedures integration.

- Coordination Times. The light brigade FSO is the focal point of fire support coordination in this setting. He is a key link from the light brigade to the division FSE and to supporting artillery. He faces a coordination problem because of his lack of TACFIRE capability. As in the planning phase, coordination requires mixing of automated and manual procedures. The coordination process slows down at nodes where the mix occurs, namely at the division FSE and the reinforcing artillery battalion. The net effect is more complex coordination actions that take longer to resolve.

- Execution Times. TACFIRE compatibility problems cause heavy/light execution times to exceed the heavy base line standard. Figure 4-1 compares the DS battalion and reinforcing battalion execution times against the heavy standards using ten various missions.[1]

The non-TACFIRE DS battalion exceeds the standard in six of ten mission. This is due to slower mission processing times in a non-TACFIRE battalion. The reinforcing battalion exceeds the standard in all ten missions. This is caused by the time required to first transmit the mission by voice and then to enter voice mission data into the TACFIRE system. Appendix F outlines the time comparison calculations used to produce the data shown in figure 4-1.

Figure 4-1

FIRING UNIT/ TYPE MISSION	HEAVY STANDARD DS/REINF	DIRECT SPT BN CAPABILITY	REINF BN CAPABILITY
BN MASS / IRREG SHAPED TGT	4:20/6:20	3:55	*6:25
BTRY FFE / IRREG SHAPED TGT	2:50/3:20	*3:25	*4:55
BN FFE WHEN READY	2:40/3:30	*2:55	*4:15
BTRY FFE WHEN READY	2:20/2:50	*2:25	*3:55
BN MASS FO ADJUSTS	7:20/7:10	*7:40	*8:15
BTRY FO ADJUSTS	8:10/8:40	*8:20	*8:55
BTRY FFE PRIORITY TGT	1:15/1:15	*1:20	*1:55
BTRY FFE IMMED SUPPRESSION	1:45/1:45	1:35	*2:00
BTRY FFE IMMED SMOKE	1:45/1:45	1:35	*2:00
BTRY FIRES FINAL PROTECTIVE FIRES	:55/:55	:50	*1:35

* indicates execution time that exceeds the standard

These execution time delays impact on the timeliness of the combined massed fires of the direct support and reinforcing battalions. This is important because massed fire support is absolutely essential for the light brigade to successfully defend and delay against a Soviet motorized rifle division. The direct support battalion in this setting has 105mm howitzers which do not have the firepower capability of the 155mm howitzers

that are organic to heavy forces.

These execution time delays are significant for several reasons. First, they add to the other fire support delays caused by other problems. Next, they force elements to compensate for the delays by planning around them or increasing mission request lead times. Finally, they exceed the limit for time sensitive missions such as priority targets, immediate suppression, and final protective fires.

This is especially critical for targeting purposes. For example, a mechanized force moving at 15 kilometers per hour will move 250 meters in 60 seconds. A 15-30 second delay in mission processing would result in a 60-120 meter discrepancy in target location and thus would significantly degrade the effects of the fire mission.

Solutions and Conclusions.

Solutions. There are various solutions which can resolve many of these fire support C^2 problems. The heavy/light fire support system can implement some of these in the short term in order to reduce the impact of the problems on fire support synchronization during heavy/light operations. Other solutions are longer-term fixes subject to budgetary considerations. The four categories below highlight some of the short term solutions.

Doctrine. Detailed communications planning

for fire support nodes identifies potential range problems. This supports better management of critical retransmission resources that can eliminate the impact of range limitations. Net structures with designated voice nets, as previously discussed, can supplement digital fire nets and can provide flexibility for mixed communications.

Detailed analysis of unit operating procedures will highlight specific considerations for mixing manual and automated fire support planning, coordination and execution. This analysis should focus especially on sections covering C^2, fire direction, fire support planning / coordination, and communications.

Several publications suggest TACFIRE / non-TACFIRE options that minimize the impact of mixing manual and automated C^2 procedures. Effective implementation and tailoring of these options can significantly reduce problems in heavy/light fire support C^2 communications and procedures. The four options below have specific advantages and disadvantages.[4]

Option 1. The non-TACFIRE Battalion sends a liaison team to the TACFIRE Battalion. This has minimum impact on operations. But, there is no digital link between the units, and thus C^2 is limited to voice nets only.

Option 2. Units collocate Fire Direction Centers. The non-TACFIRE unit still controls its own units. This eliminates the need for a liaison team. On the other hand it provides a lucrative target to the enemy.

Option 3. The non-TACFIRE Battalion maintains a separate FDC, but its batteries are controlled by the TACFIRE unit, and a digital link is established from the TACFIRE to all battery computer systems. This allows all requests for fire, fire support coordination, and fire order transmissions to be sent digitally. However, the liaison team from the non-TACFIRE unit may not be able to keep its unit properly informed of the situation or fire mission processing. Also, the non-TACFIRE unit batteries may be untrained in maintaining digital communications with TACFIRE.

Option 4. Units collocate TOCs and FDCs. The non-TACFIRE batteries are linked digitally to TACFIRE. This allows fire requests, fire support coordination measures, and fire orders to be sent digitally and a liaison team is not required. However, it also provides a lucrative target to the enemy.

Equipment. Augmentations from heavy forces can provide redundancy to the light forces communication system. There are not sufficient amounts of TACFIRE equipment available to generate augmentation packages for light forces. The feasibility of such TACFIRE augmentation is questionable because of operator training and equipment installation requirements.

One augmentation option in this scenario would include providing an ad hoc TACFIRE equipped, fire support element to the light brigade FSO. The 52nd

Mech's reserve brigade would provide the the equipment and the operators. This augmentation would supplement earlier TACFIRE/non-TACFIRE options.

Such an augmentation option has a price. The reserve brigade would lose some TACFIRE capability. The brigade would be forced to use manual procedures and voice communications in one of its subordinate battalion FSEs.

Force Structure. Experienced liaison officers with transportation and communications are a costly investment that pay high returns over time. By exchanging liaison officers, the 52nd DIVARTY and the DS battalion could significantly minimize procedural disconnects. Since neither of the units are authorized extra liaison officers, a compromise solution with reduced capability might be more realistic. For example, the DIVARTY could provide access to a radio and transportation for an experienced fire support NCO from the light DS battalion.

Training. The main C^2 burden falls on the heavy organization, which must adjust its fire support system to integrate the light forces. Heavy units must specifically train key fire support nodes such as the division FSE, brigade FSE and artillery battalion fire direction centers to operate within the communications and procedural constraints of heavy/light operations.

Conclusions. There are a number of communications and procedural problems that impacted on C^2 efforts to synchronize fire support for heavy/light operations in

this hypothetical setting. A "business as usual" approach would not meet doctrinal standards for fire support communications and procedures. Figure 4-3 summarizes C^2 problem areas in terms of category, criteria and operational impact.

Figure 4-3
Fire Support Command and Control Problem Areas

CATEGORY/ CRITERIA	IMPACT NEGLIGIBLE	SIGNIFICANT
COMMUNICATIONS		
RANGE		X
AVAILABILITY		X
COMPATIBILITY		X
SECURITY	X	
NET STRUCTURE		X
*PROCEDURES		
PLANNING TIMES		X
COORDINATION TIMES		X
EXECUTION TIMES		X

V - SUMMARY AND CONCLUSIONS

Summary of Analysis Results.

Using historical insights, contemporary lessons learned and analysis of current capabilities, this study highlights and examines key C^2 problems that degrade the

synchronization of fire support for heavy/light operations. Communications problems exist due to a variety of causes which include operating range limitations and incompatible systems. Communications problems, compressed planning timelines, and a lack of mutual understanding of respective capabilities combine to produce C^2 procedural problems that in turn affect the timeliness of fire support planning, coordination and execution. Figure 5-1 summarizes the results of this study by category, criteria, chapter and impact.

Figure 5-1
Fire Support Command and Control Problem Areas

CATEGORY/ CRITERIA	IMPACT BY CASE: COTENTIN CASE NEG	COTENTIN CASE SIG	REFORGER NTC NEG	REFORGER NTC SIG	CURRENT CAPABILITY NEG	CURRENT CAPABILITY SIG
COMMUNICATIONS						
RANGE		X		X	X	
AVAILABILITY		X		X		X
COMPATIBILITY		X		X		X
SECURITY	X		X		X	
NET STRUCTURE	X			X		X
PROCEDURES						
PLANNING TIMES	X			X		X
COORDINATION TIMES		X		X		X
EXECUTION TIMES		X		X		X

Summary of Solution Considerations.

This study addresses a number of solutions that show potential for minimizing the impact of fire support C^2 problems. The four categories below summarize final observations concerning possible solutions.

Doctrine. Minor doctrinal updates in the form of heavy / light annexes could bridge the procedural gap by including a wide range of fire support C^2 considerations. Several agencies have done some work in this area, but it is available only in bits and pieces. Consolidating this work into a single expanded annex with detailed fire support C^2 considerations would be valuable. Such an annex would help units further analyze and modify their own operating procedures.

I recommend a heavy / light fire support operations annex that organizes the issues using the battlefield operating systems as a framework. The annex should consider three possible heavy / light options: (1) a light division attached to a heavy corps, (2) a light brigade attached to a heavy division, and (3) a light battalion attached to a heavy brigade.

The command and control section of this annex should include a discussion of communications, procedures, personnel, and facilities issues based on analysis of the three options above. It should also include considerations from chapter four of this study.

Equipment. Limited augmentation of light forces is a realistic option, but one that involves tradeoffs. Augmenting light forces with additional communications assets along with a limited TACFIRE capability would provide redundancy and improved compatibility.

Light TACFIRE, scheduled for fielding in FY 90 will greatly enhance fire support C^2 for the heavy/light mix. The system will provide an automated capability for light forces and is fully compatible with the TACFIRE system used by heavy forces. Thus, it will resolve the compatibility problems and reduce the planning, coordination and execution problems.

Budget cuts, however, are an ever present danger that could reduce or scale down the fielding. The minimal acceptable level of fielding for each division would include the following items: ten Light TACFIRE terminals, enough upgraded (FIST) digital message devices for all battalion and brigade fire support sections, and forward entry devices for all forward observers.[1]

Force Structure. Given current resource constraints, any force structure additions to provide liaison slots are probably out of the question. Out-of-hide liaison officers, even though costly, are still a good investment.

As a minimum, light forces should provide a liaison officer to the higher, heavy headquarters fire support

element. This location would provide a unique vantage point from which to monitor both maneuver and fire support activities. The heavy division artillery should send liaison officers to the light force headquarters fire support element and to the fire direction center of any supporting light artillery battalion.

Training. C^2 is the training issue. Thus, the regularly scheduled TACFIRE sustainment training in heavy divisions is an ideal setting for heavy / light C^2 training. TACFIRE sustainment training is CPX oriented and includes all the key fire support players such as maneuver cells, fire support elements, fire support teams, artillery fire direction centers, and artillery operations / intelligence sections. It is a perfect setting for integrating cells to emulate light fire support C^2 activities.

Light forces have a more difficult training challenge because they currently cannot emulate the automated C^2 fire support operations of heavy units. Thus, light divisions should arrange for fire support personnel to participate in heavy division TACFIRE sustainment training activities, using equipment from the division artillery units not in training cycles.

Training remains one of the surest ways to minimize the impact of a number of the C^2 problems. The fire support community must continue to push for heavy/light training opportunities at the National Training Center and during other major exercises. These provide

valuable opportunities to focus evaluation efforts to further examine heavy / light fire support issues.

Conclusion.

The battlefield value of heavy / light operations in Germany is clear. Last year, planners at army group and corps level evaluated 13 scenarios for employing light forces with forward deployed heavy forces.[2] Such operations provide a unique force mix designed to maximize combat power through combined arms synergism.

Fire support is a key contributor to this powerful synergism. It both produces and integrates destructive firepower. Synchronizing this firepower is the task of fire support C^2. As the operational linchpin of the fire support system, C^2 depends on adequate communications and sound doctrinal procedures executed by well trained organizations.

This study used historical insights, contemporary lessons learned and analysis of current capabilities to highlight serious C^2 communications and procedural deficiencies. These deficiencies can easily disrupt and delay fire support synchronization in heavy / light operations. If not resolved, they could seriously jeopardize the capabilities of the heavy / light force. Thus, these C^2 deficiencies pose a key challenge in terms of equipment, doctrine and training.

First, scheduled improvements in fire support C^2 automation are non-negotiable. They will resolve critical compatibility problems and will also provide an automatic radio relay capability to overcome range limitations.

Next, fire support doctrine updates will be invaluable. Current publications are narrowly oriented on either heavy or light forces. Thus, updates will significantly improve their heavy / light utility.

Finally, fire support organizations designated to support actual heavy / light contingencies must continue to receive high priority for participation in available heavy / light training activities. Intense and focused training is the key to developing and sustaining the critical C^2 skills required for synchronizing fire support in complex heavy / light operations.

The heavy / light force can play a key role in defensive operations on the modern European battlefield. Resolution of fire support C^2 deficiencies will help to ensure that the capabilities of the heavy / light force are optimized for that role.

Appendix A: Key Concepts and Terms

1. Heavy/light operations are an extension of the combined arms concept which seeks to maximize combat power by offsetting the inherent weaknesses of heavy forces with the inherent strengths of attached light forces. Heavy forces are categorized by their capability for ground mobility and include mechanized infantry, armor, cavalry and motorized units. Because of their mobility, heavy forces are well suited for actions in relatively unrestricted terrain. In contrast, light forces are better suited for more restricted terrain, such as heavily forested or built up urban areas, where they can gain a relative mobility advantage. Light forces include infantry, light infantry, airborne and air assault units. By tailoring heavy/light forces according to the factors of METT-T, the commander can create a wider range of tactical options and increased flexibility.[1]

2. Synchronization is the key to optimizing the combat power of heavy/light forces. It is the arrangement of critical battlefield activities in time, space and purpose to produce maximum combat power at the decisive point. The final goal of this process is to use every resource where and when it will make the greatest contribution to success.[2]

3. Fire Support is a critical battlefield operating system that contributes significantly to overall combat * power. Fire support is the collective and coordinated use of indirect fire weapons, armed aircraft, and other lethal and non lethal means to support a battle plan. Fire support includes mortars, field artillery, naval gunfire and air-delivered weapons.[3]

4. The Fire Support System is a single entity composed of three distinct components which function together to give the maneuver commander the fire support needed to accomplish the mission. These three components include target acquisition, attack systems plus command and control.[4]

5. Fire Support C^2 is the operational linchpin of the fire support system. It is the means for achieving fire support synchronization.[5] Fire support command and control is a process of planning and coordination that includes the elements of facilities, personnel, equipment, communications, and procedures.[6]

Appendix B: Criteria for Analysis of Fire Support C^2

Communications

The following expanded criteria are the basis for analyzing fire support communications equipment and net structure.

Equipment Operating Range. What are the types and doctrinal planning ranges of organic communications capabilities? How do these ranges compare with the actual disposition of forces in the example? Do key fire support nodes have any critical range limitations? Do the heavy / light forces involved have any special capability, such as retransmission systems or aerial systems, that would enable them to overcome range limitations? What type of fire support C^2 problems occur due to operating range limitations? How do units overcome these problems?

Equipment Availability. Do the heavy / light forces have all authorized communications during the operation? Is there enough redundancy to provide for continued operations in spite of equipment failure? Are radios available for extra liaison officer requirements? Is automated / digital equipment available to help resolve compatibility problems? What type of fire support problems exist due to lack of equipment? How do units resolve these problems?

Equipment Compatibility. Is the equipment at various fire support nodes compatible? What type of

fire support interface problems does the lack of compatibility cause? How do units overcome these problems? What options are available to resolve the interface problems between the heavy units, equipped with the automated Tactical Fire Support system (TACFIRE) which uses digital communications, and light units which rely on voice communications only?

Equipment Security. Do all the fire support communications systems have a secure capability? What communications security problems does the heavy / light fire support system encounter? What are the options for resolving these problems?

Net Structure. Do the doctrinal net structures provide an adequate number and type of nets for fire support operations in heavy / light operations? If not, what problems occur? How does the fire support system resolve net structure problems?

Procedures

The Artep Mission Training Plan (AMTP) for field artillery battalions establishes specific time standards and guidelines for fire support tasks. The heavy division time standards serve as the base line for the criteria. The rationale is that the heavy force capabilities to plan, coordinate and execute fire support tasks will drive the pace and tempo of fire support operations in a European setting. The expanded

criteria listed below are the basis for examining fire support procedures.

Planning Times. Fire support planning determines target types to be attacked, means of attack, and timing of attack. The AMTP standards require that planning be finished in time to allow for the following actions to be completed:

- transmission of the plan to lowest level
- review of the plan and resolution of duplications
- processing of targets and computation of data
- rehearsal of the plan by key fire support personnel

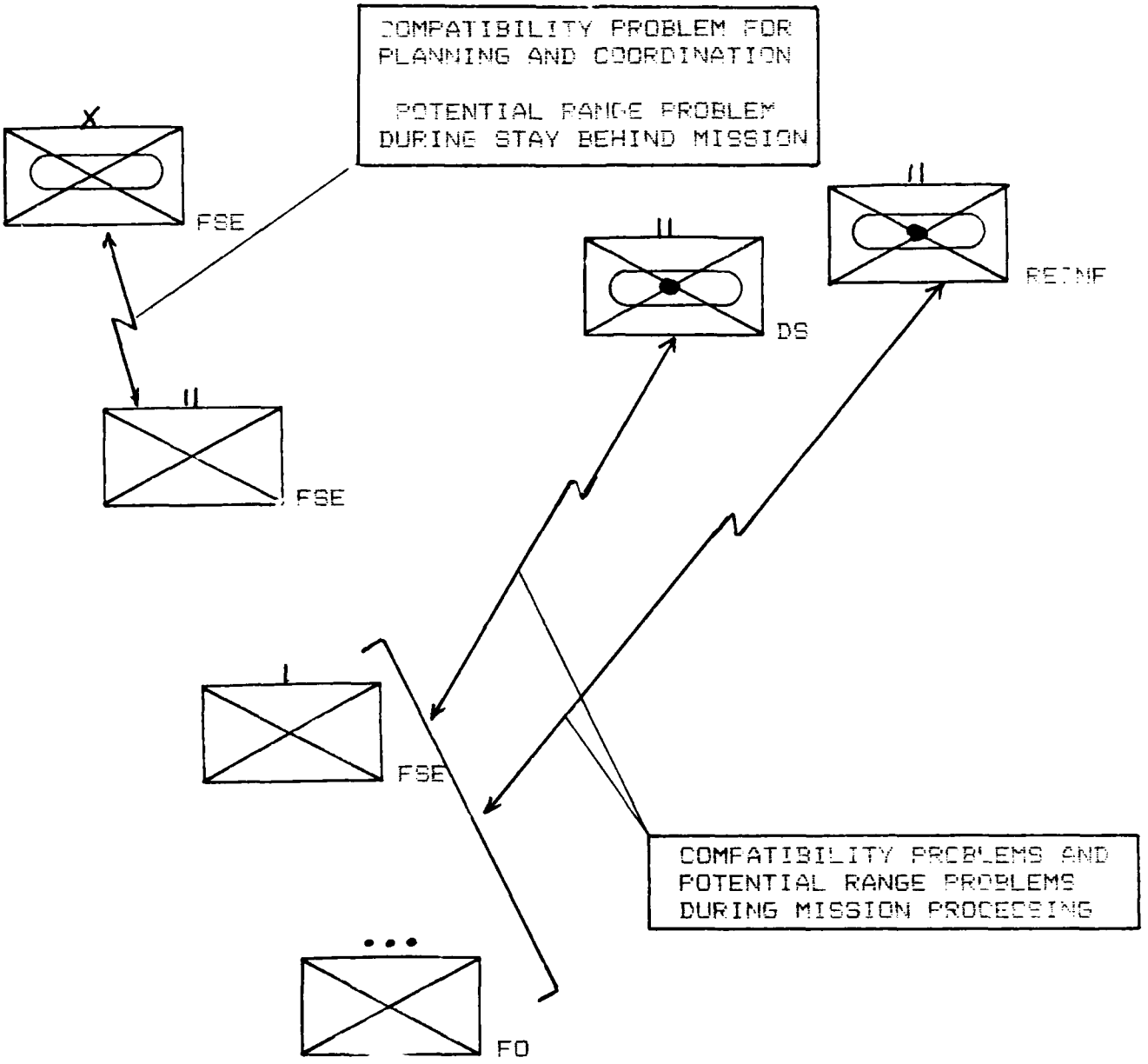
The key question is whether or not heavy / light force can conduct fire support planning in sufficient time to allow these other actions to occur.

Coordination Times. Fire support coordination is the continuous process of implementing fire support plans and managing fire support assets. This process involves many tasks to include; processing tactical information, tasking target acquisition and delivery systems, managing terrain and movement, and clearing fires. The AMTP standards require units to conduct the coordination as rapidly as possible in order to provide timely fires. The key question is whether or not the heavy / light mix can conduct fire support coordination as fast as a pure heavy force which is the base line standard.

Execution Times. Execution of fire support is the actual attack of targets by specific assets. The AMTP lists time standards by type of fire mission and unit firing. It identifies specific time limits are identified for each fire support agency that must process the mission in a typical fire mission sequence.

The matrix below highlights time standards in minutes for a variety of fire missions. These time standards are for a heavy, TACFIRE equipped unit.

FIRING UNIT TYPE MISSION	FWD OBSVR	BN FDC	BTRY FDC	GUNS	TOTAL
BN MASS / IRREG SHAPED TGT	1:25	2:00	:25	:30	4:20
BTRY FFE / IRREG SHAPED TGT	1:25	:30	:55	:30	2:50
BN FFE WHEN READY	:55	:50	:25	:30	2:40
BTRY FFE WHEN READY	:55	:30	:55	:30	2:20
BN MASS FO ADJUSTS	2:15	:50	1:45	2:30	7:20
BTRY FO ADJUSTS	2:35	:30	2:35	3:00	8:10
BTRY FFE PRIORITY TARGET	:20	0	:25	:30	1:15
BTRY FFE IMMED SUPPRESSION	:55	0	:20	:30	1:45
BTRY FFE IMMED SMOKE	:55	0	:20	:30	1:45
BTRY FIRES FINAL PROTECTIVE FIRES	:15	0	:10	:30	:55


COMPATIBILITY PROBLEM FOR
PLANNING AND COORDINATION
POTENTIAL RANGE PROBLEM
DURING STAY BEHIND MISSION
FSE
FSE
DS
REINF
FSE
COMPATIBILITY PROBLEMS AND
POTENTIAL RANGE PROBLEMS
DURING MISSION PROCESSING
FO

Appendix D: Current Capabilities - Task Organization

52d Mechanized Division Task Organization

1st Bde/21st LID (OPCON)
- 2-66 Inf
- 2-67 Inf
- 2-68 Inf
- 2-45 FA (105,T) (DS)
- A/21st Engr (DS)

1st Bde
- TF 1-77 Mech
- TF 1-5 Armor
- TF 1-25 Armor
- 1-40 FA (155,SP) (DS)

2nd Bde
- TF 1-77 Mech
- TF 1-79 Mech
- TF 1-2 Armor
- 1-41 FA (155,SP) (DS)

3rd Bde
- TF 1-80 Mech
- TF 1-81 Mech
- TF 1-3 Armor
- TF 1-4 Armor

52d Avn Bde

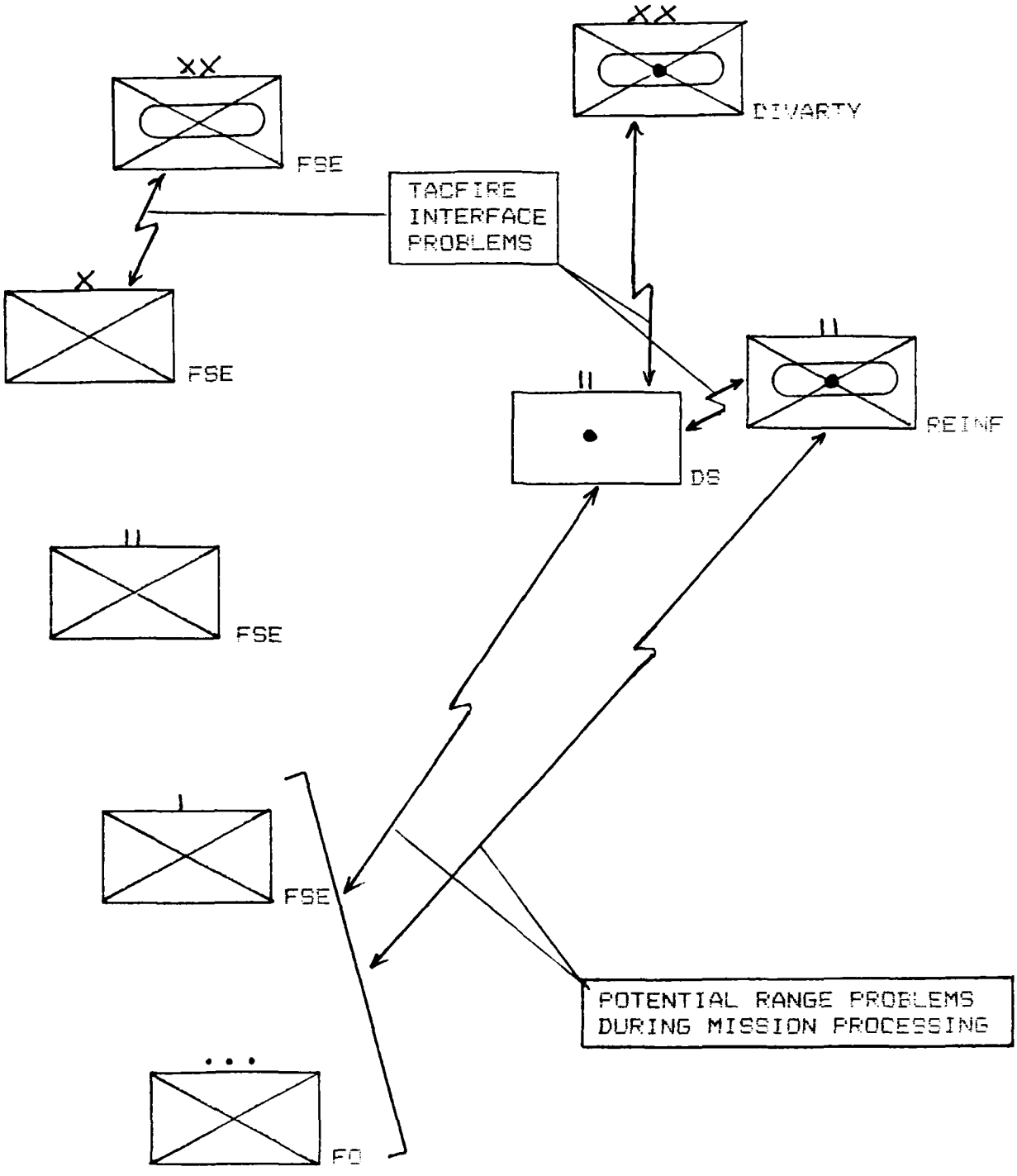
52d DIVARTY (-)
- B/20 FA (TAB)
- A/52 (MLRS) (GS)
- 1-42 FA (155,SP) (GS, o/o DS 3rd Bde)

66th FA Bde (GSR to 52d DIVARTY)
- 2-611 FA (203,SP) (GSR 1-40 FA, o/o GSR 1-42 FA)
- 2-612 FA (203,SP) (GS, o/o R 1-42 FA)
- 2-641 FA (155,SP) (R 2-45 FA)
- 2-642 FA (155,SP) (R 1-40 FA)
- 2-643 FA (155,SP) (R 1-41 FA)
- C/2-675 FA (MLRS) (GS)
- A/680th (TAB)

510th Engr Cbt Bn (Corps)(OPCON)

511th Engr Cbt Bn (Corps)(OPCON)

Appendix E: Current Problem Areas



Appendix F: Current Capabilities - Execution Times

1. Heavy DS Standard. Heavy DS standards for figure 4-2 are extracted from the ARTEP Mission Training Plan for Field Artillery Battalions, Appendix A, Fire Mission Accuracy and Time Standards (TACFIRE/BCS/DMD).

2. Heavy Reinforcing Standards. The reinforcing unit was a heavy battalion operating in conjunction with a light DS battalion. This standard is a modified heavy DS standard which includes the reinforcing battalion mission time for each mission.

3. DS Battalion Capability. the DS battalion in the analysis is a light battalion and the standards are extracted from the ARTEP Mission Training Plan for Field Artillery Battalions, Appendix A, Fire Mission Accuracy and Time Standards (BCS/no DMD).

4. Reinforcing Battalion Capability. This capability was calculated using the following combination for each of the missions analyzed.

Forward Observer Time (BCS/no DMD):_____
+
Tactical Fire Direction Time / Bn (BCS/no DMD):_____
+
* Voice Transmission Time to Reinforcing Bn:15 sec
+
* Reinforcing Bn Input Time Into TACFIRE:30 sec
+
Fire Direction Time/Reinf Bn (TACFIRE/BCS/DMD):_____
+
Battery Fire Direction Time(TACFIRE/BCS/DMD):_____
+
Gun Section Time(TACFIRE/BCS/DMD):_____

= Total:_____

* These times are fixed for each mission. All other times are extracted from Appendix A tables.

ENDNOTES

Chapter One

1. Fire support doctrine for brigade level operations is packaged in two excellent manuals that focus specifically on heavy or light operations. Field Manual 6-20-40, Tactics, Techniques, and Procedures for Fire Support for Brigade Operations is for heavy units and Field Manual 6-20-50, Tactics, Techniques, and Procedures for Fire Support for Brigade Operations is for light units. Neither contains considerations for heavy / light operations.

2. Huba Wass de Czege, NATO Interim Report: Employment concepts for Light Infantry In Europe, (SAMS reprint - FT Leavenworth, August 1988), p. 2.

3. LTG John R. Galvin, " Heavy-Light Forces and The NATO Mission." Infantry, Vol 74 (July-August 1984).

4. Wass de Czege, op. cit., 4.

5. U.S. Army Field Manual 71-100, Division Operations (Final Draft, Washington D.C., 1988), p. A-1.

6. U.S. Army Center for Army Tactics (CTAC), DA DCSOPS Briefing - Heavy/Light Operations, (Ft Leavenworth, KS, 1989), Fire support Issues List.

7. U.S. Army ARTEP Mission Training Plan for the Field Artillery Battalion, (draft),(USAFAS, Fort Sill, Ok. 1989), Appendix A.

Chapter Two

1. Roland G. Ruppenthal, Utah Beach to Cherbourg. (Washington DC, 1947), p. 10.

2. Gordon A. Harrison, Cross Channel Attack, (Washington DC, 1951), p. 386.

3. Russel F. Weigley,Eisenhower's Lieutenants. (Indiana, 1981), p. 96-106.

4. U.S. Army Field Manual 7-24 (Obsolete) Communications in the Infantry Division, (Washington D.C., 1944), p. 95-104.

5. U.S. Army 4th Infantry Division, Division Artillery After Action Report: Jun 1944 - Jan 1945, HQ, 4th Infantry Division, 1945, communications annex.

6. U.S. Army Field Manual 7-24 (Obsolete) Communications in the Infantry Division, (Washington D.C., 1944), p. 97 and p. 270 in 1950 version.

7. U.S. First Army, Artillery Information Service Memorandum #5, HQ, First Army, 1944, p. 43-45.

8. Michael D. Doubler, Busting the Bocage: American Combined Arms Operations in France, 6 June - 31 July 1944,(Fort Leavenworth, KS,1988), p. 37. The U.S. First Army, Artillery Information Service Memorandum #8. HQ, First Army, 1945, Section II documents multiple requirements for increases in observers, liaison officers and communications equipment for all type field artillery organizations.

9. U.S. Army Field Manual 7-24 (Obsolete) Communications in the Infantry Division, (Washington D.C., 1944), App 2.

10. U.S. Army Field Manual 7-24 (Obsolete) Communications in the Infantry Division, (Washington D.C., 1944), para 125-126.

11. U.S. First Army, Artillery Information Service Memorandum #5 HQ, First Army, 1944, p. 23.

12. U.S. Army Field Manual 6-135 (Obsolete), Field Artillery Forward Observers, (Washington D.C.,1944), p. 27.

13. U.S. Army 101st Airborne Division, Division Artillery After Action Report: May 1944 - May 1945 / Annex 9, HQ, 101st Airborne Division, 1945, June 27 entry.

14. See previous discussions of equipment operating ranges and compatibility problems.

15. U.S. First Army, Artillery Information Service Memorandum #5 HQ, First Army, 1944, p. 15.

16. U.S. Army Field Manual 6-135 (Obsolete), Field Artillery Forward Observers, (Washington D.C.,1944), p. 25-27.

17. U.S. First Army, Artillery Information Service Memorandum #5 HQ, First Army, 1944, p. 1.

18. U.S. First Army, Artillery Information Service Memorandum #4 HQ, First Army, 1944, p. 10-11.

19. U.S. First Army, Artillery Information Service Memorandum #4 HQ, First Army, 1944, p. 61.

20. U.S. First Army, Artillery Information Service Memorandum #8, HQ, First Army, 1945, Sect II, Part II.

21. U.S. First Army, Artillery Information Service Memorandum #8, HQ, First Army, 1945, Sect II, Part II.

22. U.S. First Army, Artillery Information Service Memorandum #5 HQ, First Army, 1944, Section II.

Chapter Three

1. Heavy / light forces in both cases consisted of a heavy brigade, a light infantry battalion with its habitual fire support elements and teams, a direct support artillery battalion (heavy division), and a reinforcing artillery battalion (heavy corps artillery).

2. Heavy / light forces in this case included an armored cavalry regiment, a light infantry battalion with its habitual fire support elements and teams, and a corps artillery brigade in direct support of the regiment.

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